Claims

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1. Apparatus for transmitting and receiving signals that is in conformity with a communications standard or among multi-standard and comprises a carrier signal modulated by a wanted signal, said communications standard defining a plurality of communications channels having central frequencies that are separated from one another by a fixed frequency referred to as a channel spacing, the modulated carrier signal occupying one of said plurality of communications channels, the apparatus including the first high frequency(HF) PLL 103 to generate f1 and f2 at an actual local oscillator frequencies which differs from said central frequency of the channel occupied by said wanted signal by a frequency difference f3 whose frequency is generated by a programmable mixed-signal waveform generator 104 followed with Digital to Analog Converters (DAC) and a filters. The mixing operation can be up conversion or down conversion.

For up conversion f_up=fa+fb it is generated by cos(2*pi*f_up*t) = cos(2*pi*fa*t) * cos(2*pi*fb*t) - sin(2*pi*fa*t) * sin(2*pi*fb*t). and sin(2*pi*f-up*t) = sin(2*pi*fa*t) * con(2*pi*fb*t) + cos(2*pi*fa*t) * sin(2*pi*fb*t).

For down conversion f_down=fa-fb,it is generated by cos(2*pi*f_down*t) = cos(2*pi*fa*t) * cos(2*pi*fb*t) + sin(2*pi*fa*t) * sin(2*pi*fb*t) and sin(2*pi*f-down*t) = sin(2*pi*fa*t) * cos(2*pi*fb*t) - cos(2*pi*fa*t) * sin(2*pi*fb*t).

The transmitter 107 mixes the transmitted data signal and the final carrier frequency signal produced by mixing f1,f2 and f3 frequency signals, that is fc=((f1+f2)+f3), from

the GRFS in FIG 1. The receiver 108 can be in direct conversion receiving or multi-stage down conversion by the frequency plan defined in this invention as shown in FIG2 and FIG3. or claim2. And multiple transceivers in different carrier channels can share the same f1 and f2 frequency generators in a communication system like multi-port WLAN switch or hub access points as also shown in FIG.1 .

2. A method according to claim 1 wherein the operation as shown in Table.1

For example, a direct conversion operation as shown in FIG. 2 , IEEE802.11a WLAN f1=5280MHz, f2=0 and f3=-100MHz to 40MHz with 20MHz step for lower 5GHz band (5180MHz:20MHz:5320MHz) and f1=5940MHz , f2=0 and f3=-195MHz to -135 MHz with 20MHz step for upper 5GHz band (5745MHz:20MHz:5805MHz).

For IEEE802.11b/g WLAN (2412MHz:5MHz:2472Mz), f1=2420MHz, f2=0, f3=-8MHz to 52MHz with 5MHz step for IEEE802.11b and 20MHz for IEEE802.11g , the 11MHz baseband digital clock is also generated by 5280MHz/480. For IEEE802.11b multistage low-IF receiver, f1+f2+f3=fc-22MHz as shown in FIG.10 , the 22MHz difference is processing by digital mixer operation with a 88MHz clock from 5280MHz/60. The same low-IF approach can also applied to other wireless communication standard in the innovative frequency planning and synthesizer design. Since, the transceiver and base-band is WLAN oriented, the circuit blocks in transmitter and receiver paths such as data converters and DSP processing power in base-band are good enough to handle all the communication standard listed in table1. That is this frequency planning and architecture of the general radio frequency synthesizer can be applied in direct conversion and low-IF

and high-IF transceiver architectures. Therefore, this invention can be a general radio frequency synthesizer for current and future wireless communication standard.

For Bluetooth (2402MHz:1MHz:2480MHz), f1=2420MHz, f2=0MHz and f3=-18MHz to 60MHz with 1MHz step.

For WCDMA (1920MHz:5MHz:1980MHz), f1=1980MHz, f2=0MHz and f3=-60MHz : 5MHz:0MHz

For WCDMA (2110MHz:5MHz:2170MHz), f1=2090MHz, f2=0MHz and f3=20MHz : 5MHz: 80MHz

For multi-stage operation with a central 660MHz Band Pass Filter (BPF) as shown in FIG.3 or in Table 1, the positive and negative sign operation of f2,can also be decoded by the base-band signal processing. The f3 frequency range is for current carious wireless communication standard, it can be extended to several hundred mega hertz and the resolution can be changed by the apparatus shown in FIG.6 to meet next generation wireless standard requirement.

3. A method and apparatus of single frequency generators according to claim1 is shown in FIG. 4. For 5280MHz, it is generated from a 20MHz crystal 401 reference signal with quadrature VCO 405 circuits to produce HF f1 signals I,Q. For minimizing phase noise for some communication standards like IEEE802.11a/g OFDM system, the frequency tuning of the PLLs' charge pump 404 are disabled during transmitting or receiving data packets. Innovative Superharmonic Quadrature Injection-Locked Frequency Dividers as shown in FIGS. 5 are invented to produce a single constant frequency analog division

operation with IQ quadrature outputs. The divider can also be implemented by a frequency divider with poly-phase filters to generate the IQ quadrature phase outputs.

5. A method and apparatus of mixer in claim 1 is Shown in FIG. 7. A two-port double balanced mixer of up-conversion or down-conversion is defined in claim 1. The mixer can also be implemented by a multiplier with image rejection filters or band-pass filters. Three input port mixer operations can be a cascade of two two input port mixer or integrated in one circuit as triple balanced mixer shown in FIG6.

6. A method and apparatus for instant/simultaneously channel switching is then be achieved according to claim1-5.

10. Method and apparatus apply not only the standard in claim2 or table 1. but also for current others communication standard and the future next generation communication standards.

12. The claim of the frequency synthesizer for multimode and multi-standard wireless communication can be any combinations of the communication standards in claims 2 / Table 1 and claim 10.